

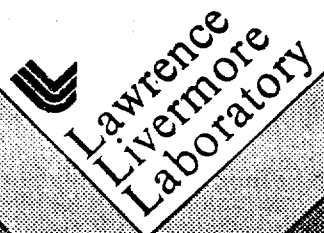
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USE ALL FORMS OF ENERGY

D. R. Stephens

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The logo for Lawrence Livermore Laboratory, featuring a stylized 'L' symbol above the text 'Lawrence Livermore Laboratory' which is arranged in three lines and slanted to the right.

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USE ALL FORMS OF ENERGY

D. R. Stephens

Lawrence Livermore National Laboratory, Livermore, CA 94550

Here we are in 1980, in the seventh year of an energy crisis, and yet we're still not geared up to handle it. We've been in a crisis mode since the oil embargo of 1973: the natural gas shortages during the winter of 1976-1977 didn't help, nor did the Iranian oil cutoff of 1979, nor does the impending collapse of the nuclear industry under the weight of public opinion, led by the radical environmental movement.

Can you remember the good old days when atomic energy was considered the solution for cheap, abundant electricity, when gasoline was 35¢/gallon, when the real price of energy declined every year, and we had every expectation that our standard of living would increase without limits. We were scandalized by inflation rates of 6% or by unemployment rates of 5%. Let's face it - the future's just not what it used to be!

There are obvious solutions to our energy crisis, of course. These solutions have been proposed, again and again, starting in the 1960's. The peaking and decline of our domestic oil and gas supplies was accurately forecast in the 1960's by M. King Hubbert and others. These estimates included scenarios of some of the disastrous consequences of the increased cost of energy imports, but these early warnings were disregarded.

A direct consequence of this inaction by the Federal Government is that the U.S. surely faces a difficult decade of the 1980's - far worse than the 1970's. It will take a lot more political courage and foresight than our leaders have shown, to date, for us to pull through without significant reductions in our standard of living and influence in foreign affairs, and possible even a major war.

The answers to our energy crisis are of course, to produce more domestic energy and to use less energy. Our economy can't grow, our living standards will decline, and our social problems can't be resolved, unless we do this. Depending on unreliable foreign sources of oil is hazardous to our national security and our economic health. But contrary to some "experts", there is no one form of energy which will save us. We must use all forms of energy available - to paraphrase the National Research Council's Committee on Nuclear and Alternative Energy Systems [CONAES] - let's put our eggs in as many baskets as possible.

Let's take a look at just how precarious our imported oil situation really is. There is a serious possibility of a complete cutoff of Middle East oil during the 1980's, stemming from Islamic resurgence, Arab nationalism, and from Soviet attempts, rather successful attempts, to destabilize the region. In addition to Afghanistan and Iran, at least eleven coups have been attempted against the Saudi Arabian ruling family during the last three years.

The U.S. daily demand for oil is 16.7 million barrels - 8.6 million barrels produced domestically and 8.1 million barrels imported. Of the 8.1 million imported barrels, 2.1 million are imported from the Middle East. So we can breathe a sigh of relief - 2.1 million of our 16.7 million daily barrels of oil are imported from the Middle East - that's only 12%, and with inventories, the strategic oil reserve, and possibly other sources, we could live without Middle Eastern oil for awhile - right? Wrong.

The United States is signatory to the International Agency Agreement, which requires that the burden of oil shortages be shared with all the 20 importing countries forming the pact, independent of the source of supply. The results of that agreement, if all 21 million barrels of oil produced per day from the Middle East are disrupted, is a decrease in imported oil to the U.S. of 7.4 million barrels of oil per day, or 44% of our total oil supply. Results of such a cutoff would be staggering. Even with radical conservation efforts, carpooling, mass transit, fuel switching, and all-out production of other forms of energy, such a consequence would plunge the U.S. into a tailspin. The U.S. and the industrialized world would be plunged into the worst depression since the 1930's. Probably the U.S. would renegotiate the treaty to minimize our losses - the other importing nations would likely be forced into military action.

It doesn't have to happen. The U.S. is one of the world's most energy rich nations. We have the finest engineering and scientific capability in the world. We have the manpower, the know-how, the raw materials, and the capital. U.S. energy needs can be reduced immediately by conservation, but coal and nuclear power will be needed to supply electricity. We must minimize the use of oil and gas for electricity. For example, California

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generates 82% of its electricity from oil and gas. Oil should only be used for transportation fuels. Gas and electricity (with heat pumps) should be used for home heating, and gas used to replace oil in the industrial sector where coal cannot be used.

Coal can be made clean and nuclear can be made safe. We have learned a great deal from the Three Mile accident. The operators were poorly trained, the controls were poorly designed, and on the regulatory side, there are too many regulations, too many lawyers, and too little sense. Solutions to these problems are obvious, and with the exception of regulations, are being implemented.

France and Japan take six years to build a nuclear power plant while it takes 11 - 14 years in the U.S. This makes all the difference between very cheap and very expensive electrical power. This counterproductive situation must be corrected. We should stop dithering around with studies of nuclear waste disposal and get on with the job. We know how to do it. Remember, in its twenty-six years of nonmilitary existence, nuclear power already contributes more electricity than all hydropower. We must and we will make full use of nuclear.

Our main problem is that of transportation fuels and the primary problem there is the availability of gasoline. The consensus of the innumerable studies of transportation is that the answer is not, in general, improved rapid transit: although desirable, rapid transit can make only a small contribution due to our dispersed population. We need more fuel efficient autos and electric vehicles. These will make a big difference in the magnitude of our imported oil requirements.

We can reduce our dependence on imported oil and gas still further by requiring that the U.S. convert oil and gas burning power plants and industrial boilers to burn coal, convert oil burning home furnaces to burn gas, and to make gas and oil from coal and oil shale. We then can use the gas to heat our homes and use the oil to power our transportation systems.

Thirty percent of all homes are heated by oil. By insulating all homes, reductions of about 30 percent in demand should be possible. By converting oil burners to gas, the nation would be able

to heat all homes with the same amount of gas the U.S. now uses.

Thanks to OPEC and the Ayatollah, it is now economic to convert coal to gas and oil shale to oil. The private sector, thank goodness, is beginning to do just that. There will continue to be an ever-increasing synthetic fuels industry in the U.S. if some sort of balance can be struck between the legitimate, and conflicting, requirements of synthetic fuels availability and environmental protection. Environmental effects of energy use are serious and hard to manage. So are the effects of not having energy!

With the knowledge we now have, and acting with intelligence and resolve, we can solve our short term energy problems - that is, in the decade of the 1980's. But we should not ignore our longer range energy problems, and that means R&D. We will need cleaner, more efficient coal conversion processes. Solar energy will become cost effective as the price of energy rises: the recent CONAES study sets 5% of U.S. energy produced by solar by 2000 as a realistic goal. Farther down the road - past 2000 - the breeder reactor, and possibly fusion and geothermal will also power the U.S. as our oil and gas resources decline. But even by 2000, the primary energy supplies will be oil, coal, gas, nuclear, hydro and solar, in that order. R&D will help us to efficiently produce and efficiently consume those sources of energy. Investment in R&D is necessary for our future, and, fellow members of the R&D community, it is up to us to make the most of that investment for the future wellbeing of our nation.

In summary, with conservation, conversion of oil and gas burning boilers to coal, full use of nuclear, more fuel efficient automobiles, and creation of a synthetic fuels industry based on coal and oil shale, we can resolve our short term energy crisis. Short term R&D on more efficient synthetic fuels processes, electric vehicles, and solar will carry us past 2000. Over the long run, coal, the breeder reactor, solar and possibly fusion and geothermal will replenish our energy needs as the world supplies of oil and gas decline. We have the money, manpower, knowhow, the coal, the uranium, and the oil shale. We need political courage. The energy will not be cheap, and environmental risks are involved. But the risks of not producing the energy are even more severe. We can and must do it.